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Applications of Artificial Intelligence

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ABSTRACT

Artificial Intelligence is the ability of a system or a program to think and learn from experience. It is machine-displayed intelligence that simulates human behavior or thinking and can be trained to solve specific problems. AI is coming with trends that are really going to make quite significant differences in various industries and capabilities. It is all about efficiency, scalability, and, above all, decision-making. Applications of AI are revolutionizing ways of doing business and interacting with customers across sectors, from health care to entertainment. AI has found applications in almost every business sector. This paper explores different applications for AI across industries in the real world.

KEYWORDS: *artificial intelligence, machine learning, AI, generative AI, applications of AI.*

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INTRODUCTION

Artificial intelligence (AI) is the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. It is the capability of computational systems to perform tasks typically associated with human intelligence, such as learning, reasoning, problem-solving, perception, and decision-making. It is an emerging technology that will change everything about how businesses will be conducted and people will work with machines. The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal or defined operations. Figure 1 shows the symbol of AI [1].

Advanced features like predictive analytics, autonomous systems, and intelligent automation have brought industry revolution through AI. AI is revolutionizing various sectors by introducing efficiencies and innovations in addressing pressing global challenges. Different industries are witnessing transformations due to artificial intelligence in the areas of efficiency, accuracy, and innovation. More and more businesses have been allocating their budgets into AI technology to keep up their competitive advantages over time [2].

WHAT IS ARTIFICIAL INTELLENCE?

The term "artificial intelligence" (AI) is an umbrella term John McCarthy, a computer scientist, coined in 1955 and defined as "the science and engineering of intelligent machines." It refers to the ability of a computer system to perform human tasks (such as thinking and learning) that usually can only be accomplished using human intelligence [3]. Typically, AI systems demonstrate at least some of the following human behaviors: planning, learning, reasoning, problem solving, knowledge representation, perception, speech recognition, decision-making, language translation, motion, manipulation, intelligence, and creativity.

The 10 U.S. Code § 2358 define artificial intelligence as [4]:

1. "Any artificial system that performs tasks under varying and unpredictable circumstances without significant human oversight, or that can learn from experience and improve performance when exposed to data sets.

2. An artificial system developed in computer software, physical hardware, or other context that solves tasks requiring human-like perception, cognition, planning, learning, communication, or physical action.
3. An artificial system designed to think or act like a human, including cognitive architectures and neural networks.
4. A set of techniques, including machine learning, that is designed to approximate a cognitive task.
5. An artificial system designed to act rationally, including an intelligent software agent or embodied robot that achieves goals using perception, planning, reasoning, learning, communicating, decision making, and acting."

AI provides tools creating intelligent machines which can behave like humans, think like humans, and make decisions like humans. The main goals of artificial intelligence are [5]:

1. Replicate human intelligence
2. Solve knowledge-intensive tasks
3. Make an intelligent connection of perception and action
4. Build a machine which can perform tasks that requires human intelligence
5. Create some system which can exhibit intelligent behavior, learn new things by itself, demonstrate, explain, and can advise to its user.

AI is not a single technology but a range of computational models and algorithms. The concept of AI is an umbrella term that encompasses many different technologies. AI is not a single technology but a collection of techniques that enables computer systems to perform tasks that would otherwise require human intelligence. The major disciplines in AI include [6]:

- Expert systems
- Fuzzy logic
- Neural networks
- Machine learning (ML)
- Deep learning
- Natural Language Processors (NLP)
- Robots

These computer-based tools or technologies have been used to achieve AI's goals. Each AI tool has its own advantages. Using a combination of these models, rather than a single model, is recommended. Figure 2 shows a typical expert system, while Figure 3 illustrates the AI tools. These tools are gaining momentum across every industry. Analytics can be considered a core AI capability.

APPLICATIONS OF ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) applications are software programs that use AI techniques to perform specific tasks. AI is revolutionizing industries by automating tasks, optimizing decision-making, and fostering innovation across fields like healthcare, education, and finance, making it a critical driver of progress in the digital era. The applications of artificial intelligence are endless. Figure 4 shows some applications of AI [7]. We now take a look at how the application of AI has benefited different domains. We will avoid applications that are already fully covered in our previous works [8,9]. Common applications include the following [1,10-12]:

1. *Robotics*: Robots are machines capable of moving and performing actions without human intervention. Artificial intelligence is one of the major technologies that provide the robotics field with a boost to increase their efficiency. In fact, AI may be regarded as the practice of transforming digital computers into working robots. AI provides robots to make decisions in real time and increase productivity. AI enhances robots' capabilities, enabling them to perform complex tasks precisely and efficiently. In industries like manufacturing, AI-powered robots can work alongside humans, handling repetitive or dangerous tasks, thus increasing productivity and safety. Robots automate repetitive tasks, carry out quality control and optimize assembly processes by learning from experience to improve their performance. Figure 5 shows a robot used in a factory [13].
2. *Virtual Assistants:* Perhaps the application used by most people would be the digital assistants on our various pieces of technology. These days, virtual assistants are a very commodity possessed by various industries. Almost every household has a virtual assistant that controls their appliances at home. Examples include Siri, Alexa, Google Now, and Cortana, which respond to voice commands to search keywords on the web, start playlists of songs, send text messages or answer calls. They are gaining popularity because of the user experience they provide. They are virtual assistants designed to understand natural language and to learn, over time, the tastes and habits of their interlocutors. Virtual assistants use natural language processing (NLP) to understand voice commands, provide information, and manage smart home devices. Millions of its articles have been edited by bots which however are usually not artificial intelligence software.

3. *Marketing:* Marketing has been a key area for improvement and the latest trends in AI. AI in marketing helps businesses understand customer behavior, optimize campaigns, and deliver personalized experiences. AI tools can analyze data to identify trends, segment audiences, and automate content delivery. AI plays a crucial role in audience segmentation in marketing by profiling consumer preferences from online activities to serve targeted digital ads. Natural language generation allows brands to engage at scale through personalized website content and social response bots. Artificial intelligence is transforming every aspect of advertising, from personalization to performance analysis to delivery optimization. With AI, marketers can analyze customer data and behaviors to create hyper-targeted ads designed to increase engagement and conversion rates.
4. *E-Commerce:* Many online shopping and ecommerce platforms use AI to streamline their customer experience in a variety of ways. AI has transformed the e-commerce industry by enhancing customers' shopping experiences and optimizing businesses' operations. AI in the field of e-commerce helps the organization to establish a good engagement between the user and the company. AI-powered recommendation engines analyze customer behavior and preferences to suggest products, leading to increased sales and customer satisfaction. Additionally, AI-driven chatbots provide quick customer support, resolving queries and guiding shoppers through their purchasing journey.
5. *Retail:* AI has transformed the retail and ecommerce space by enhancing the customer experience and improving operations. AI-powered recommendation engines analyze consumer data, preferences, and purchase histories to deliver highly personalized product suggestions, increasing customer satisfaction and driving sales. Virtual assistants and chatbots provide round-the-clock support, answer queries, and guide customers through purchasing.
6. *Transportation:* The transportation sector emerges as a focal point of innovation, harnessing the power of Artificial Intelligence (AI) to reimagine the future of mobility and logistics. The integration of AI technologies into transportation systems is ushering in an era of smart, efficient, and sustainable mobility. Travel routing and ride-sharing which used real-time traffic for a specific ride are possible due to the use of Artificial Intelligence. AI optimizes travel and transport by improving route planning, managing traffic flow, and enhancing passenger experiences. AI-powered systems can analyze data to predict delays, optimize schedules, and provide real-time updates to travelers. In public transportation, AI is facilitating the development of smart mobility solutions.
7. *Media and Entertainment:* This field uses artificial intelligence for creating various contents. The entertainment industry also uses artificial intelligence for the categorization and classification of content according to the user. AI transforms the entertainment industry by personalizing content recommendations, creating realistic visual effects, and enhancing audience engagement. AI can analyze viewer preferences, generate content, and create interactive experiences. AI helps entertainment companies analyze large volumes of data and then decide mainstream content and make effective business decisions. AI drives personalized content recommendation engines on streaming services (like Netflix and Spotify) and is used in game design to create more realistic and adaptive experiences. AI has been used to compose music of various genres.
8. *Human Resource:* Here AI is used to detect any kind of malpractice behavior and many other things. AI can screen resumes and rank candidates based on their qualifications, predict candidate success in given roles, and automate repetitive communication tasks via chatbots. The screening process of candidates can be automated to reduce the timeframe and eliminate excess resources for this task. This helps shortlist potential candidates and resumes by assessing insightful information in no time. The human resources field leverages AI to streamline processes, enhance talent acquisition, and improve employee engagement. AI is used to detect any kind of malpractice behavior and many other things. AI-driven recruitment platforms can streamline hiring by screening resumes, matching candidates with job descriptions, and even conducting preliminary interviews using video analysis.
9. *Government:* The public sector and the government stand to benefit greatly from incorporating AI into every element of their jobs. The application of AI in government must take into account evolving workloads, privacy and security concerns, and system compatibility with old systems. AI is being used to improve public safety, detect crime, and provide citizen services. AI is a mainstay of law-related professions.

Algorithms and machine learning do some tasks previously done by entry-level lawyers. Law enforcement has begun using facial recognition systems (FRS) to identify suspects from visual data. Various countries are deploying AI military applications.

10. *Surveillance:* AI is also used in the field of surveillance by recognizing far faces and objects. This helps the military to protect their areas. AI facial recognition systems are used for mass surveillance, notably in China.
11. *Computer Vision:* Computer vision allows computers to identify and interpret visual content. This technology is used in a variety of applications, such as self-driving cars, facial recognition, and object detection.
12. *Smart Cities:* Smart cities are one of the best illustrations of how most of these artificial intelligence applications can be integrated at scale for transformational impact. As urban populations swell globally, artificial intelligence is emerging as a critical solution for modernizing infrastructure management for burgeoning megacities. Computer vision-powered traffic lights and route recommendations additionally cut congestion.
13. *Smart Homes:* The most advanced form of applications of artificial intelligence in the real-world are being implemented in homes, and are becoming smarter every day. Various devices like smart locks, smart switches, etc., are increasingly becoming compatible with various devices, and the application of smart homes is becoming more accessible to the general population every day.
14. *Astronomy:* Artificial intelligence is used in astronomy to analyze increasing amounts of available data and applications, mainly for "classification, regression, clustering, forecasting, generation, discovery, and the development of new scientific insights." It could also be used for activities in space such as space exploration.
15. *Navigations:* GPS technology uses AI to provide the best available route to the users for traveling. It helps the user to choose their type of lane and roads which increases the safety features of a user. This feature allows users to interact with the AI using a hands-free feature which allows them to drive while communicating with the navigation system.

BENEFITS

Artificial intelligence powers applications across virtually all sectors of the economy. AI capabilities, particularly those related to mimicking human-level understanding will significantly transform a variety of industries, from healthcare to transportation. AI algorithms can analyze massive datasets, recognize patterns, and make data-driven predictions or recommendations. Some benefits of AI are depicted in Figure 6 [14]. Other benefits include [15]:

- *Automation:* By automating boring and repetitive manual processes, AI actually helps in improving efficiency and productivity. AI reduces human error by automating critical processes. Automation minimizes human effort in tasks, but questions arise concerning whether creativity and decision-making are being sacrificed. Automating everyday tasks saves the organization's staff while also increasing output.
- *Personalization:* Using this feature, customers would be able to see those products based on their interest pattern and that eventually will drive more conversions. A common thread weaving through AI applications is the emphasis on personalization and user-centric experiences. Whether in retail with personalized recommendations, healthcare with individualized treatment plans, or transportation with smart mobility solutions, AI is championing a future where services are tailored to the unique needs and preferences of individuals. Using this feature, customers would be able to see those products based on their interest pattern and that eventually will drive more conversions.
- *Customer Service:* There are many websites now that offer customers the ability to chat with customer support. It's one of the most general real world ai applications. These chat support bots are little more than automated responders. The more advanced customer service chatbots are able to extract information from the site and present it to you on request.
- *Voice Assistance:* This feature allows users to interact with the AI using a hands-free feature which allows them to drive while communicating with the navigation system. With the help of AI algorithms, this feature can be used in multiple ways to save time and provide help to assist users when required.
- *Predictive Analytics:* AI models predict the likelihood of future conditions such as diabetes, strokes, or heart attacks by analyzing patient data including medical histories, lifestyle and genetic information. They can analyze historical data and patterns to make effective decisions. This can be achieved by empowering different techniques

used in machine learning, deep learning and artificial intelligence.

- *Predictive Maintenance:* AI can predict when a vehicle's components require maintenance or replacement. It can forecast issues before they result in breakdowns by analyzing data from sensors embedded in the vehicle. AI-driven predictive maintenance is reshaping the way transportation fleets are managed.
- *Human-AI Collaboration:* A noteworthy aspect is the synergy between human expertise and AI capabilities. In healthcare diagnostics, financial decision-making, retail experiences, manufacturing processes, and transportation systems, AI serves as a collaborative tool, augmenting human capabilities and enabling more informed and efficient decision-making.

CHALLENGES

Although the introduction of artificial intelligence has been a welcome change in today's world, it brings along advantages that can become drawbacks. AI comes with concerns, such as potential job loss, bias in decision-making, and privacy risks. The key is using AI responsibly so we can enjoy its benefits while managing its challenges. Other challenges include [16]:

- *Limitations:* Humans are still capable of doing a variety of complicated activities better than AI. Tasks that demand creativity are beyond the capabilities of AI computers. AI cannot yet demonstrate empathy or critical reasoning.
- *Ethical Concerns:* AI ethics is a multidisciplinary field that studies how to optimize AI's beneficial impact while reducing risks and adverse outcomes. Ethical aspects such as fairness and transparency are continuously integrated into the development of AI. Businesses will have to embrace ethical frameworks for responsible use while leveraging its transformative powers to all sectors. An ethical approach to AI governance requires the involvement of a wide range of stakeholders.
- *Bias:* Bias in AI algorithms leading to unfair outcomes. An algorithm may reinforce social inequalities if trained on a biased dataset. If organizations don't prioritize safety and ethics when developing and deploying AI systems, they risk committing privacy violations and producing biased outcomes.
- *Data Risks:* AI systems rely on data sets that might be vulnerable to data poisoning, data tampering, data bias or cyberattacks that can lead to data breaches. Organizations can mitigate these risks by protecting data integrity and implementing security and availability throughout the entire AI lifecycle. Dependent on large data networks, AI systems are also particularly susceptible to security risks.
- *Fairness:* Although machine learning, by its very nature, is a form of statistical discrimination, the discrimination becomes objectionable when it places privileged groups at systematic advantage and certain unprivileged groups at systematic disadvantage, potentially causing varied harms.
- *Transparency:* Organizations should implement clear responsibilities and governance structures for the development, deployment and outcomes of AI systems. Increased transparency provides information for AI consumers to better understand how the AI model or service was created.
- *Compliance:* Many regulatory frameworks, including GDPR, mandate that organizations abide by certain privacy principles when processing personal information. It is crucial to be able to protect AI models that might contain personal information, control what data goes into the model in the first place, and to build adaptable systems that can adjust to changes in regulation and attitudes around AI ethics.

FUTURE OF ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy. The evolution of AI technologies has seen an exponential rise in the last decade. These technologies have established themselves as a core requirement across various industries and continue to leverage their importance and need. As technology evolves at a breakneck pace, artificial intelligence (AI) stands out as a key catalyst, ushering us into a future where anything is possible. The days are not too far when your refrigerator might know more about your diet and suggest you the best food to eat. Or your chatbot like Alexa or Siri might even become your professional assistant.

CONCLUSION

Underlying AI is the idea that it is possible to create machines that are able to learn and think independently. AI has a vast range of applications across nearly every industry, from improving everyday conveniences to solving complex challenges in specialized fields. The applications span across industries, revolutionizing how we live, work, and interact with technology. The function and popularity of artificial intelligence are soaring by the day. The

world of technology relies heavily on different types of AI applications as they determine the future of technology. More information on the applications of artificial intelligence is available from the books in [21-28] and the following related journals:

- The AI Journal
- AI Magazine
- Journal of Intelligence

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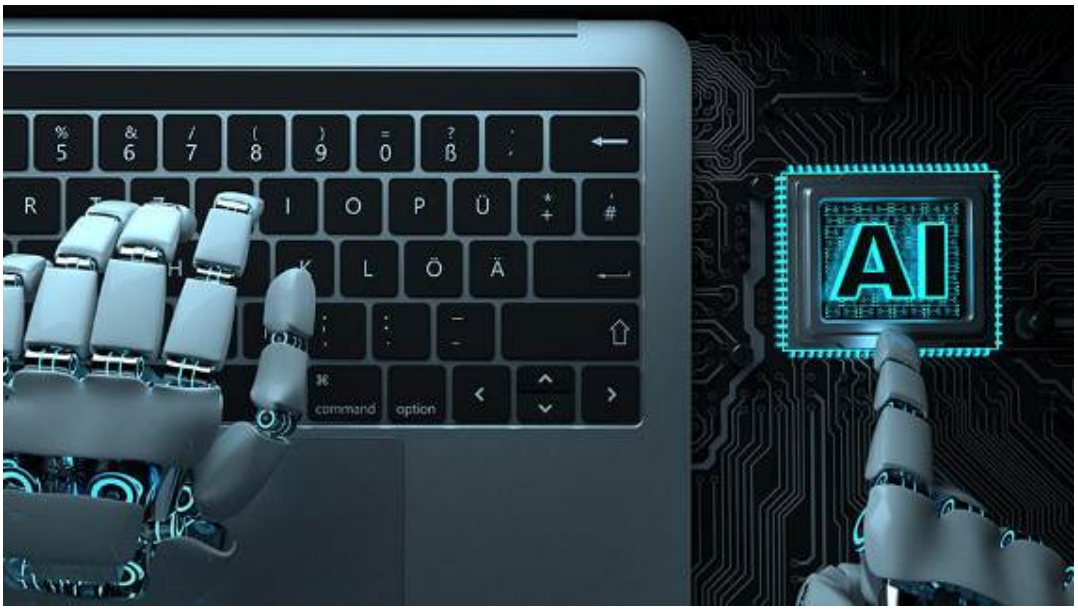

Figure 1 Symbol of AI [1].

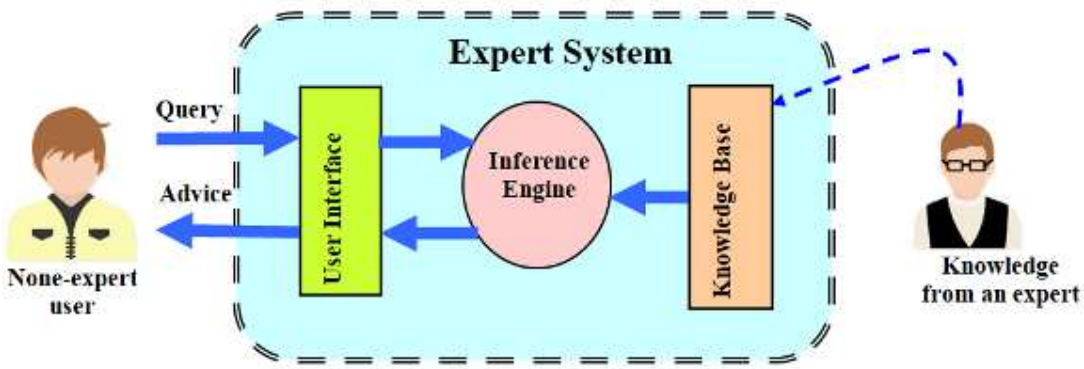

Figure 2 A typical expert system.

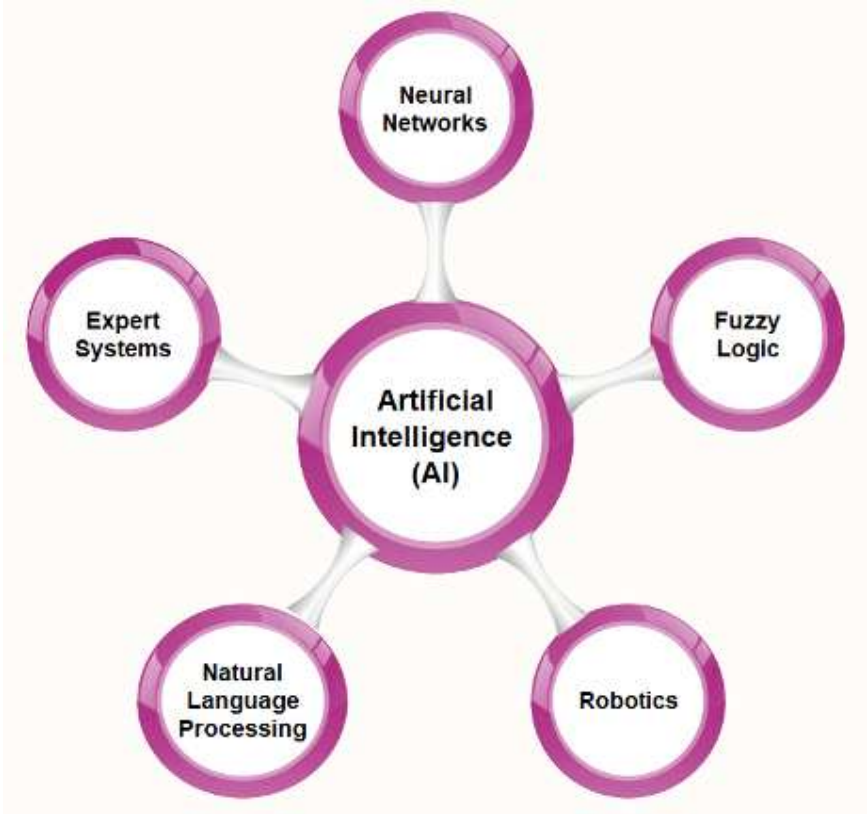

Figure 3 AI tools.

Figure 4 Some applications of AI [7].

Figure 5 A robot used in a factory [13].

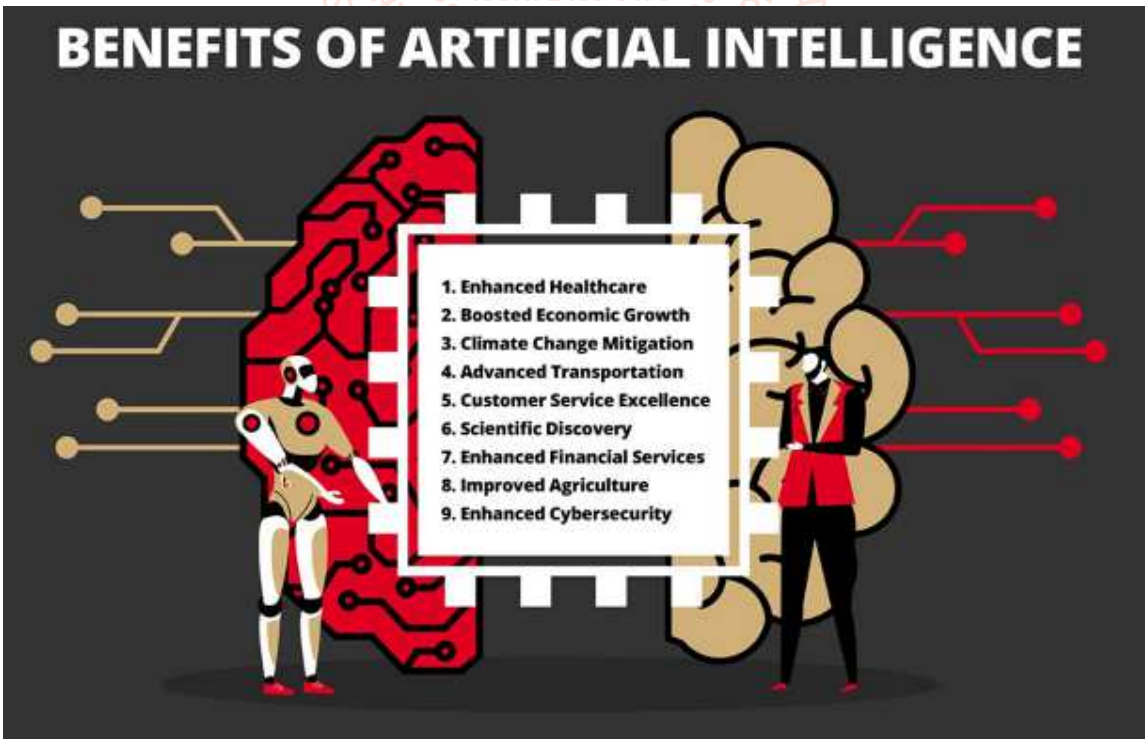

Figure 6 Some benefits of AI [14].